BOD AND TSS REDUCTION STUDY
FOR THE
INTERNATIONAL PAPER ANDROSCOGGIN MILL

Jay, Maine

August 15, 2003

WOODARD & CURRAN
Engineering · Science · Operations

41 Hutchins Drive
Portland, ME 04102
(207) 774-2112

www.woodardcurran.com

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EXECUTIVE SUMMARY

The Maine Department of Environmental Protection (DEP) is considering new BOD and TSS license limits for the three paper mills that discharge to the Androscoggin River – International Paper (IP) in Jay, ME, MeadWestvaco (MWV) in Rumford, ME; and NexforFraser (Fraser) in Berlin, NH. This report provides information regarding potential wastewater improvement options to reduce effluent BOD and TSS loadings from the International Paper (IP) Jay Mill. The DEP's so-called "actual" BOD and TSS discharges contained in the Androscoggin River Modeling Report are not equivalent to the mill's current performance. DEP's so-called "actual" limits are more restrictive than the Jay Mill's current performance, and would result in unacceptable violations each year.

The Jay mill has devoted considerable effort to ratcheting down BOD and TSS discharges over the last 15 years. Their summer TSS Town limit has been reduced to just 25 percent of EPA's Best Practicable Treatment (BPT) limits, and their effluent actual BOD discharge levels are approximately 25 percent of BPT. IP has maintained an adequate safety margin between their normal operating level and license limits, resulting in zero discharge violations in the last five years. This high performance comes at considerable expense. Rather than saving money by operating closer to their license limits, the mill currently spends a substantial sum of money each year to maintain an adequate safety margin. To achieve this, IP has implemented a combination of in-mill improvements and good management of the wastewater treatment plant. IP adopts this operating strategy for four reasons: (1) it's the "right thing to do," from an environmental standpoint; (2) to account for normal variations in influent quality, plant operations and effluent quality; (3) to allow for economic expansion; and (4) to maintain the flexibility to respond to changing product and market demands.

Several wastewater treatment technologies were reviewed to determine the estimated costs for IP to come into compliance with the various BOD and TSS discharge license limits being considered. Table ES-1 in Appendix A provides a summary of the projected capital and O&M costs associated with complying with each proposed set of limits. As discussed above, the Jay Mill has already expended considerable capital to control BOD and TSS levels in its treated effluent and spends approximately $1.3 million annually to remain well below the existing BOD and TSS limits and supply oxygen to Gulf Island Pond. These operating costs include additional aeration, polymer, sludge handling and disposal, and GIPOP oxygen diffuser costs.

The next set of limits being considered would involve reducing the effluent BOD limit by 27 percent to a monthly average limit of 8,000 lb/day. The proposed TSS limit of 19,000 lb/day is actually higher than the mill's existing Town and FERC summer limit of 12,000 lb/day. Compliance with this reduced BOD license limit would require a two-phase approach. The first phase would involve implementing a number of improvements to the existing waste treatment facility. These include: additional aerators/mixers, a new belt filter press, a coagulant addition system, a new DCS system, decreasing the volume of the aeration basin, and flow control for the RAS pumps. The estimated capital cost for these upgrades is $1.6 million, not including the cost of decreasing the aeration basin volume. The estimated annual O&M cost is $1.5 million for these improvements. These costs do not include the baseline costs described above. There is a chance that these improvements would not be sufficient to achieve compliance with the 8,000 lb/day BOD limit. If this is the case, tertiary treatment, such as dissolved air flotation (DAF), would have to be installed to further polish the treated effluent. The estimated capital cost of installing a DAF system is $15.5 million, including the plant upgrades listed above.

The 60 percent license reductions proposed by DEP involve reducing effluent BOD and TSS limits down to so-called "actual" discharge levels. The 4,300 lb/day BOD limit would result in violations at concentrations of 14 to 15 mg/l in IP's treated effluent, which is considered extremely low for integrated kraft mills. A total of 22 violations would have been incurred over the last 4.5 years if these limits had been in place. IP would have to consistently decrease their effluent BOD discharge concentrations to single digit (e.g. less than 10 mg/l) values in order to comply with DEP's so-called actual limits and still maintain a minimum operating safety margin. Integrated kraft mills are not required to operate at these levels. Effluent polishing with membrane technology would be required, which is not proven technology for an integrated kraft mill.

Zero discharge has never been accomplished for integrated kraft mills without adverse secondary environmental impacts, such as groundwater contamination. It is also important to understand that none of the costs summarized in Table ES-1 include the cost of a second GIPOP oxygen diffuser.

1. INTRODUCTION

The Maine Department of Environmental Protection (DEP) is considering new BOD and TSS license limits for the three paper mills that discharge to the Androscoggin River – International Paper (IP) in Jay, ME, MeadWestvaco (MWV) in Rumford, ME; and NexforFraser (Fraser) in Berlin, NH. This report provides information regarding potential wastewater improvement options to reduce effluent BOD and TSS loadings from the IP Jay Mill. The DEP's so-called "actual" BOD and TSS discharges contained in the Androscoggin River Modeling Report are not equivalent to the mill's current performance and, if imposed as permit limits, would require significant additional reductions at substantial cost.

This report provides information regarding potential options to reduce effluent BOD and TSS loadings from the IP Jay Mill to the Androscoggin River. More specifically, the report has three primary objectives, as listed below.

1. Describe wastewater treatment technology options and associated costs required to achieve compliance with DEP's proposed BOD and TSS limits.
2. Briefly identify the actions that IP has already taken to minimize BOD and TSS discharges.
3. Explain why DEP's proposed so-called "actual" BOD and TSS discharges contained in the Androscoggin River Modeling Report are actually more restrictive than the Jay Mill's current performance.

The report is divided into the following five sections: Executive Summary, Introduction, Compliance History, Options and Costs to Achieve Compliance, and Conclusions and Recommendations.

2. COMPLIANCE HISTORY

The Jay Mill has made the conscious decision to operate in a manner that maximizes treatment efficiency and minimizes BOD and TSS discharges to the Androscoggin River. This has been accomplished through a combination of: (1) implementing a number of in-mill changes to reduce loadings to the treatment plant; and (2) spending approximately $1 million in capital improvements installed in 1992 to allow the treatment plant to operate at the levels it is presently attaining. The Jay Mill could have easily decreased performance to reduce cost, while still achieving regulatory compliance. Instead, the Jay Mill currently spends approximately $1.3 million per year in O&M to maintain an adequate margin of compliance to ensure compliance at all times with DEP's existing BOD and TSS limits. This includes the cost of: operating extra aerators to maximize BOD reduction; adding polymer to the secondary clarifiers to control TSS discharges; and IP's portion of the cost to operate the GIPOP diffuser, which amounts to an about $300,000 per year. The mill received a State Award in 1992 for its BOD reduction efforts, and another in 1996 for its conversion to an elemental chlorine-free bleaching process. Numerous other awards have been received for non-wastewater, environmental initiatives.

As evidenced by these awards, the Jay Mill has consistently incorporated environmental improvements to improve influent quality to the treatment plant into its long term facility planning. The Jay Mill has spent approximately $800,000 capital since 1999 on environmental improvements. A few examples of the most recent improvements are summarized below.

<u>New Screens</u> – The screens in the B-side pulp mill wet room were changed from a perforated plate screen to a slotted screen in order to increase efficiency and decrease wastewater discharges from the cleaning operation.

<u>Clean Sluicing Water</u> – The A-side wet room was modified to utilize clean mill water in place of weak black liquor as the sluicing media for conveying rejected knots. As a result, the weak black liquor is retained in the recovery cycle rather than discharged to the wastewater treatment plant.

<u>Reduced Purge Flow</u> – The purge flow from the B-side wet room to the sewer has been reduced. Prior to project completion, there was a virtually continuous purge to the sewer of 60 to 100 gpm of weak black liquor. The purge now takes place approximately every five minutes and lasts only seconds. The material drained to the sewer during these short purges is now primarily sand and grit.

<u>Level Transmitter</u> – A level transmitter was installed on the oxygen delignification system to increase the consistency and reduce variation in the process. This allows for a higher rate of delignification and reduces discharges to the wastewater treatment plant.

<u>Chute Vent</u> – A chute vent was installed on the oxygen delignification system to increase consistency and delignification, while reducing discharges to the treatment plant.

<u>Sewer Conductivity Cells</u> – Sewer conductivity cells were installed in eight recovery cycle sewers in order to more quickly alarm operators of discharges to the mill sewer system.

<u>Additional Aerators</u> – An additional 25 aerators were installed in 1992 as a result of recommendations made by a joint DEP/IP task force.

<u>Polymer Addition to Secondaries</u> – The mill started adding considerable amounts of polymer to the secondary clarifiers to maintain compliance with the reduced TSS limit after the 1997 license renewal.

IP has been successful in meeting its permit limits day in and day out, maintaining an adequate margin of safety to assure consistent compliance. To achieve this, IP has implemented a combination of in-mill improvements and good management of the wastewater treatment plant. IP adopts this operating strategy for four reasons: (1) it's the "right thing to do," from an environmental standpoint; (2) to account for normal variations in influent quality, plant operations and effluent quality; (3) to allow for economic expansion; and (4) to maintain the flexibility to respond to changing product and market demands. This operating policy is consistent with the mill's approach to maximizing the effectiveness of their treatment operations, and maintaining an adequate margin of safety. There needs to be a buffer between compliance limits and actual operating levels, in order to allow for the variations that occur in any waste treatment process. Also, as expressed by the DEP in response to comments on the Sappi Somerset Mill's proposed draft permit license (July 18, 2003), an adequate safety margin needs to be maintained for economic expansion. The DEP states in this document that "If the Department limited the permittees to historic levels of discharge every five years (the term of a permit), excess capacity built into the treatment plant designs would never be able to be utilized." IP cannot operate with BOD and TSS limits that do not allow for operating variability and economic growth.

3. OPTIONS AND COSTS TO ACHIEVE COMPLIANCE

As described above in the Compliance History section, the Jay mill has already incorporated a number of environmental improvements focused on reducing wastewater flows and loadings from the mill. These improvements have played an important role in improving treatment plant performance, allowing the mill to achieve the appreciable reductions in BOD and TSS discharges in recent years. A number of other capital upgrades were considered regarding compliance with the DEP's proposed limits. Each of these options is discussed briefly below.

<u>Increase Aeration/Mixing Capacity</u> – A thorough review of plant data showed that, in order to further reduce the already low effluent BOD concentrations, a combination of increased soluble and particulate BOD reduction may need to be accomplished. Increased soluble BOD reductions could potentially be achieved during "elevated" loading events. The increased mixing provided by the aerators would also help to further dampen the impact of "slug" loadings, thereby increasing system stability. However, this increased mixing energy in the basin would also elevate scour and the associated loading of fine solids on the secondary clarifiers.

<u>Belt Filter Press</u> – The mill's existing screw presses are limited by primary sludge to secondary sludge ratio. This ratio must be no less than 70:30 to achieve adequate sludge dryness. This requires the mill to periodically rent a belt press to control wasting and process excess secondary solids. A new, permanent belt press would be required if more stringent BOD/TSS limits were adopted, since this would cause even more secondary sludge to be generated.

<u>New DCS</u> – A new distributed process control system would be required at the treatment plant to maintain compliance with tighter permit limits. Such as system would provide operators with enhanced capability to monitor and control their processes, resulting in more efficient, effective treatment plant operation.

<u>RAS Flow Control</u> – The only means of Return Activated Sludge (RAS) flow control currently available is by turning pumps on or off. A more sophisticated flow control scheme would be required to comply with stricter permit limits.

<u>Decreased Aeration Basin Volume</u> – The mill is presently in the process of decreasing the size of the aeration basin and moving the aerators closer together. This should improve treatment efficiency and enhance secondary solids removal efficiency by reducing dead zones and the resulting deposition and re-suspension of inert solids, which can ultimately lead to secondary carry over of inert solids. This is an ongoing improvement process, and its associated costs have not been included in this report. This may change depending on final permit requirements.

<u>Trickling Filter Pretreatment</u> – A trickling filter could be installed to reduce BOD loadings to the aeration basin, and dampen their variability. This would ensure adequate soluble BOD reductions and decrease the solids loading on the secondary clarifiers. This technology, however, is known to produce odors when influent sulfur levels are elevated. For this reason, it was eliminated as a viable option.

<u>MBBR Pretreatment</u> – A Moving Bed Biofilm Reactor (MBBR) would reduce the BOD loading on the aeration basin, and dampen its variability. This would ensure adequate soluble BOD reductions and decrease the solids loading on the secondary clarifiers. On the down side, this technology is considerably more expensive than adding aerators to the aeration basin, and would not provide the level of TSS and

particulate BOD control that DAF would provide. For these reasons, MBBR pretreatment was eliminated as a viable option.

Dissolved Air Flotation – This option involves installing dissolved air flotation (DAF) after the secondary clarifiers to provide a TSS and particulate BOD reduction prior to discharging the treated effluent. DAF technology, in conjunction with coagulant/polymer addition, would be effective at reducing the magnitude of the occasional secondary effluent TSS spikes and associated particulate BOD. The negative aspects of DAF are that it would require significant capital, and that it has few applications in an integrated Kraft pulp and paper mill in North America. Although DAF is a proven technology in some applications, it has not been widely employed to reduce BOD and TSS loadings from secondary effluents in the pulp and paper industry. Sludge disposal costs would be expected to increase since sludge from these units can be difficult to manage. For reasons stated above, a new, permanent belt press would be required if tertiary treatment were installed, since it would generate even more secondary sludge. DAF technology would require a more detailed review before it could be considered viable, including an extended pilot plant trial to more fully evaluate costs and performance expectations.

Coagulant/Polymer Addition to Primary Clarifiers – A portion of inorganic losses (e.g. from paper coatings and fillers) can escape primary clarification and increase the inert solids in the aeration basin. Some of these solids may even escape removal in the secondaries. Addition of coagulant/polymer mix to the primaries during high/dispersed solids loading events can help alleviate this situation. This option, however, has a high operating cost and would do little to improve soluble BOD reduction. For these reasons, this option was eliminated from further consideration.

Coagulant/Polymer to Secondary Clarifiers – Polymer is presently added to the secondary clarifiers during the summer to help control TSS. A coagulant/polymer mixture could be added to further improve TSS and particulate BOD reductions. This option, when combined with increased aeration capacity, has the potential to marginally enhance BOD removals. However, it would have a high operating cost and would require a long term trial.

Tertiary Filtration – Both sand filters and cloth Aquadisk filters were considered. However, these options are more costly, operator intensive, and less proven than DAF. In addition, they would do nothing to address the soluble BOD issue. For these reasons, tertiary filtration was ruled out as a viable option.

Polishing Pond – A polishing pond would assist in controlling maximum daily TSS and particulate BOD events. This option was ruled out, however, due to space requirements (a minimum two-day retention time is recommended) and the potential for re-release of BOD and phosphorus.

Table ES-1 in Appendix A provides a summary of the projected capital and O&M costs associated with each proposed set of limits. As explained in the Compliance History section, the Jay Mill has already expended considerable capital (approximately \$2 million) to control BOD and TSS levels in its treated effluent. Furthermore, the mill spends approximately \$1.3 million annually to comply with the existing BOD and TSS limits and supply oxygen to Gulf Island Pond. These operating costs include additional aeration, polymer, sludge handling and disposal, and GIPOP oxygen diffuser costs. The mill has also spent substantial sums of money on extended delignification, oxygen delignification, elemental chlorine-free bleaching, and closing up the wet room. The costs of these improvements have not been included in this report.

The next set of limits being considered would involve reducing the effluent BOD limit by 27 percent to a monthly average limit of 8,000 lb/day. The proposed TSS limit of 19,000 lb/day is actually higher than the mill's existing Town (FERC) summer limit of 12,000 lb/day. Compliance with this reduced BOD license limit would require a two-phase approach. The first phase would involve implementing a number of improvements to the existing waste treatment facility. These include: additional aerators/mixers, a new belt filter press, a coagulant addition system, a new DCS system, decreasing the volume of the aeration basin, and flow control for the RAS pumps. The estimated capital cost for these upgrades is $1.6 million, not including the cost of decreasing the aeration basin volume. The estimated annual O&M cost is $1.5 million for these improvements. These costs do not include the baseline costs described above. There is a chance that these improvements would not be sufficient to achieve compliance with the 8,000 lb/day BOD limit. If this is the case, tertiary treatment, such as dissolved air flotation (DAF), would have to be installed to further polish the treated effluent. The estimated capital cost of installing a DAF system is $15.5 million, including the plant upgrades listed above. The annual O&M cost is estimated at $2.7 million.

The 60 percent license reductions proposed by DEP involve reducing effluent BOD and TSS limits down to so-called actual discharge levels. The 4,300 lb/day BOD limit would result in violations at concentrations of <u>14 to 15 mg/l</u> in IP's treated effluent, which is considered extremely low for integrated kraft mills. A total of 22 violations would have been incurred over the last 4.5 years if these limits had been in place. IP would have to consistently decrease their effluent BOD discharge concentrations to <u>single digit</u> (e.g. less than 10 mg/l) values in order to comply with DEP's so-called actual limits and still maintain a minimum operating safety margin. Integrated kraft mills are not required to operate at these levels. Effluent polishing with membrane technology would be required, which is not proven technology for an integrated kraft mill.

Zero discharge has never been accomplished for integrated kraft mills without adverse secondary environmental impacts, such as groundwater contamination. Therefore, no costs have been included for Options 10 through 12 in Table ES-1. It is also important to understand that none of the costs summarized in this table include the cost of a second GIPOP oxygen diffuser.

4. CONCLUSIONS AND RECOMMENDATIONS

In summary, we conclude the following:

- The DEP's so-called "actual" BOD and TSS discharges contained in the Androscoggin River Modeling Report are not equivalent to the mill's current performance. The proposed limits are more restrictive than the Jay Mill's current performance, and would result in an unacceptably large number of violations each year;
- IP has consistently maintained compliance with effluent BOD and TSS limits by applying an adequate safety margin to account for: normal variations in influent quality, plant operations and effluent quality, to allow for economic expansion, and to maintain the flexibility to respond to changing product and market demands;
- IP has already expended considerable capital, both in-plant and at waste treatment, to control BOD and TSS levels in its treated effluent, and spends approximately $1.3 million annually to remain well below the existing BOD and TSS limits and supply oxygen to Gulf Island Pond;
- Compliance with the 27 percent reduced BOD license limit would require a two-phased approach. The first phase would involve implementing a number of improvements to the existing waste treatment facility. The estimated capital cost for these upgrades is $1.6 million, not including the cost of decreasing the aeration basin volume. The estimated annual O&M cost is $1.5 million for these improvements. If these improvements are not successful at achieving compliance with these limits, tertiary treatment, such as dissolved air flotation (DAF), would have to be installed to further polish the treated effluent. The estimated capital cost of installing a DAF system is $15.5 million, including the plant upgrades listed above. The annual O&M cost is estimated at $2.7 million; and
- IP would have to consistently decrease their effluent BOD discharge concentrations to single digit (e.g. less than 10 mg/l) values in order to comply with the so-called "actual" limits. This would require effluent polishing with membrane technology, which is not proven technology for an integrated kraft mill.

APPENDIX A: BOD AND TSS REDUCTION TECHNOLOGIES AND COST ESTIMATES FOR INTERNATIONAL PAPER

Table ES-1: BOD and TSS Reduction Technologies and Cost Estimates for International Paper

DEP Model Run Number	Options	Compliance of Dissolved Oxygen Criteria				Maximum Algae Level (Chl-a in ppb)	BOD/TSS Reduction Technology	Capital Cost	Annual O&M Cost	Accrued benefits/losses outside of GIP		
		(Depth in ft)	% of Total Pond Volume > 5 ppm	% of Total Pond Volume > 6.5 ppm	% of Coldwater Habitat	(GPA criteria of TBD ppb represents bloom condition)				Aquatic life	Recreation	Economic value
1A	1. No changes to point source waste discharge licenses. BOD TSS TP[4] Fraser 13400 28200 164 Mead 12000 32900 241 IP 10900 38350 298 Munis 1837 1837 267 Continue operation of GIPOP1 (92,000 ppd).		67%[1]	56%[1]		19ug/l	In-mill improvements, additional aerators/mixers, polymer, sludge disposal and GIPOP1 oxygen diffuser costs	$2.0 MM	$1.3MM			
	1A. No changes to point source waste discharge licenses. BOD TSS TP[4] Fraser 13400 28200 164 Mead 12000 32900 241 IP 10900 38350 298 Munis 1837 1837 267 Continue operation of GIPOP1 (35,000 ppd). Add GIPOP2 at Lower Narrows (70,000 ppd). Total O2 injection = 105,000 ppd		(TBD)	71%		19ug/l	In-mill improvements, additional aerators/mixers, polymer, sludge disposal and GIPOP1 oxygen diffuser costs	$2.0 MM	$1.3MM			
2A	2. Reduce point source waste discharge licenses to Model levels of BOD/TSS/TP. BOD TSS TP Fraser 10200 11000 148 Mead 6300 10100 220 IP 4300 12000 268 Munis 510 715 121 Continue operation of GIPOP1 (92,000 ppd).		93%	88%		17ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
	3. Reduce BOD/TSS of point source waste discharge licenses to Model levels. Reduce modeled point source phosphorus by 1/6. BOD TSS TP Fraser 10200 11000 123 Mead 6300 10100 183 IP 4300 12000 223 Munis 510 715 101 Continue operation of GIPOP1.		(TBD)	89%		15ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
3A	4. Reduce BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce modeled point source phosphorus by 1/3. BOD TSS TP Fraser 10200 11000 99 Mead 6300 10100 146 IP 4300 12000 179 Munis 510 715 81 Continue operation of GIPOP1 (92,000 ppd).		96%	91%		12ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
April 15 Memo Not reflective of memo. Also, need to Correct for IP TSS	4A. Reduce license BOD/TSS discharge. Reduce modeled point source phosphorus by 1/3. BOD TSS TP Fraser 11000 20000 99 Mead 9000 15500 146 IP 8000 12000 179 Munis 1470 1470 81 Continue GIPOP1 (92,000 ppd).		93% Need to correct	85% Need to correct		12ug/l	Two-phased approach[5]	$1.6M to $15.5MM	$1.5MM to $2.7MM			

Table ES-2 (continued): Phosphorus Reduction Technologies and Cost Estimates for Androscoggin River Point Sources

DEP Model Run Number	Options	Compliance of Dissolved Oxygen Criteria				Maximum Algae Level (Chl-a in ppb)	Total P Reduction Technology	Capital Cost ($000)	Annual O&M Cost ($000)	Accrued benefits/losses outside of GIP		
		(Depth in ft)	% of Total Pond Volume > 5 ppm	% of Total Pond Volume > 6.5 ppm	% of Coldwater Habitat	(GPA criteria of TBD ppb represents bloom condition)				Aquatic life	Recreation	Economic value
Need to Correct for IP TSS	4B. Reduce license BOD/TSS discharge. Reduce modeled point source phosphorus by 1/3. BOD TSS TP Fraser 11000 20000 99 Mead 9000 15500 146 IP 8000 12000 179 Munis 1470 1470 81 Continue GIPOP1 (35,000 ppd). Add 2nd GIPOP at Lower Narrows (70,000 ppd). Total O2 injection = 105,000 ppd.		(TBD)	(TBD)		12ug/l	Two-phased approach[5]	$1.6M to $15.5MM	$1.5MM to $2.7MM			
	5. Reduce BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce point source phosphorus by 50%. BOD TSS TP Fraser 10200 11000 74 Mead 6300 10100 110 IP 4300 12000 134 Munis 510 715 60 Continue operation of GIPOP1 (92,000 ppd).		(TBD)	93%		10ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
	6. Reduce BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce point source phosphorus by 67%. BOD TSS TP Fraser 10200 11000 49 Mead 6300 10100 73 IP 4300 12000 89 Munis 510 715 40 Continue operation of GIPOP1 (92,000 ppd).		(TBD)	96%		8ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
	7. Reduce license BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce modeled point source phosphorus by 40%. BOD TSS TP Fraser 10200 11000 89 Mead 6300 10100 132 IP 4300 12000 161 Munis 510 715 73 Continue operation of GIPOP1 (x ppd). Add 2nd GIPOP at Lower Narrows (y ppd). Total O2 injection = 98,000 ppd.		(TBD)	98%		11ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
6A	8. Reduce BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce modeled point source phosphorus by 1/3. BOD TSS TP Fraser 10200 11000 99 Mead 6300 10100 147 IP 4300 12000 179 Munis 510 715 81 8. Continue operation of GIPOP1 (45,000 ppd). Add 2nd GIPOP at Lower Narrows (90,000 ppd). Total O2 injection = 135,000 ppd.		99%	99%		12ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			

Table ES-2 (continued): Phosphorus Reduction Technologies and Cost Estimates for Androscoggin River Point Sources

DEP Model Run Number	Options	Compliance of Dissolved Oxygen Criteria				Maximum Algae Level (Chl-a in ppb)	Total P Reduction Technology	Capital Cost ($000)	Annual O&M Cost ($000)	Accrued benefits/losses outside of GIP		
		(Depth in ft)	% of Total Pond Volume > 5 ppm	% of Total Pond Volume > 6.5 ppm	% of Coldwater Habitat	(GPA criteria of TBD ppb represents bloom condition)				Aquatic life	Recreation	Economic value
	9. Reduce BOD/TSS of point source Waste Discharge Licenses to Model levels. Reduce modeled point source phosphorus by 40%. BOD TSS TP Fraser 10200 11000 89 Mead 6300 10100 132 IP 4300 12000 161 Munis 510 715 73 Continue operation of GIPOP1 (35,000 ppd). Add 2nd GIPOP at Lower Narrows (70,000 ppd). Total O2 injection = 105,000 ppd.		99%	99%		11ug/l	Effluent polishing with membrane technology	$50MM	$2.5MM			
0B	10. Zero discharge from mills. Discontinue GIPOP1.		94%	90%			Not proven without averse secondary environmental impacts, such as groundwater contamination					
0A	11. Zero discharge from mills. Continue GIPOP1 (92,000 ppd).		100%	99%			Not proven without averse secondary environmental impacts, such as groundwater contamination					
	12. Zero discharge from mills. Continue GIPOP1 (35,000 ppd). Add 2nd GIPOP at Lower Narrows (70,000 ppd). Total O2 injection = 105,000 ppd.		100%	100%			Not proven without averse secondary environmental impacts, such as groundwater contamination					
	13. No changes to point source waste discharge licenses. BOD TSS TP[4] Fraser 13400 28200 164 Mead 12000 32900 241 IP 10900 38350 298 Munis 1837 1837 267 Discontinue GIPOP1. Remove Gulf Island Dam.	N/A		N/A			In-mill improvements, additional aerators, polymer, sludge handling and disposal	$2.0MM	$1.0MM			

1 Non-attainment of DO criteria at water surface above GIPOP1. Below GIPOP1, the added oxygen result in some attainment near surface. Value reflects the correct pond volume.
2 Some non-attainment of DO criteria is predicted by water quality model in a small area directly upriver of GIPOP1 above this depth.
3 Non-attainment estimates obtained by interpolation of model runs at 10' depth intervals.
4 "Licensed" TP estimated as discharge of phosphorus at full licensed flow and measured concentration.
5. First phase involves additional aerators/mixer, a new belt press, coagulant addition system, new DCS, decreasing the volume of the aeration basin, and RAS flow control. Second phase involves tertiary treatment in the form of DAF. These costs do not include baseline costs.